that they have a great dislike to violet light however obscure, and a preference for dark green and red; but we can hardly tell whether this effect depends on any visual perception, or on a general sense of discomfort in the one case and pleasure in the other analogous to the effects of heat and cold upon ourselves.

The last two lectures give a clear and condensed summary of the present state of our knowledge as to prehistoric man, and are well worthy of study by those who may be inclined to doubt the value of the conclusions arrived at by the new science of Prehistoric Archæology. There is here of course nothing but what is well known to all who have paid attention to the subject. It is, however, interesting to note how sharp and striking the contrast between the Palæolithic and Neolithic ages appears, when their characteristic features are briefly summed up side by side as we here find them. Whether we consider the tools, weapons, and other works of art, the character of the contemporary animals, the physical geography of the country, or the distribution of man himself, we cannot but be impressed with the profound chasm, which in Europe at least, separated the Palæolithic from the Neolithic man. And as, since the glacial epoch passed away we have no evidence of any physical changes calculated to produce such a chasm, it seems natural to suppose that it was the result of the cold period itself, and that, as many geologists now maintain, Palæolithic man lived before the glacial epoch and during interglacial mild periods, while Neolithic man made his first appearance only when the ice-age had finally passed away. On any other theory we have no adequate cause adduced for a discontinuity so vast in its proportions and extending over so wide an area. A. R. W.

OUR BOOK SHELF

Dairy Farming; or, The Theory, Practice, and Methods of Dairying. By J. P. Sheldon, assisted by leading authorities in various countries. Part I. (London: Cassell, Petter, and Galpin, 1879.)

THE prospectus of this work promises us a thorough treatment of all parts of the important subject of dairy farming. The selection, breeding, and feeding of dairy cows; the production, treatment, and disposal of butter and cheese; the plants or crops used in feeding animals; dairy buildings, and soils adapted for dairy farms; such are some of the subjects embraced in the scheme of Mr. Sheldon's serial work, the publication of which, in monthly parts, has recently commenced. The first number, being chiefly occupied with general introductory remarks, hardly affords a fair sample of what the bulk of the book is likely to be. These prefatory pages do, however, contain a good deal of interesting matter—matter important to many persons besides dairy farmers. Some of the statistics of milk- and cheese-production here given are very striking. For instance, we are told (p. 9) that about 500,000 tons of ripe cheese could be made from the milk annually produced in the United Kingdom, when the quantity of milk required for rearing and fattening calves has been deducted. But, in point of fact, much milk is consumed as such in food, while from that which is submitted to further dairy operations a good deal of butter is made. The approximate estimates, therefore, for the amounts of milk and milk-products in question will stand somewhat as follows for the United Kingdom:—Milk annually consumed as such, 525,000,000 gallons; 126,000 tons ripe cheese from 350,000,000 gallons; 89,295 tons of butter from 550,000,000 gallons. When the cheese, butter, and condensed milk imported from abroad are added to the home production, some notion of the vastness of the amount of dairy products consumed by the population of the British Isles may be gained. Thus, 98,000 tons of cheese are annually brought into this country from the Continent, the United States, and Canada; while the yearly import of butter approaches 90,000 tons. The value of our imports of butter and cheese together is just 15,000,000*l.* sterling.

It seems somewhat ungracious to say one word in disparagement of any part of an undertaking which promises so well as does Mr. Sheldon's "Dairy Farming." But we feel bound to hint that more care should be taken in securing the accuracy of any physiological and chemical explanations that it may be thought expedient to introduce into the volume. The figures and statements on pp. vi. and vii. of the "Introduction" require revision. We give an instance. We are told (p. vi.) that 1 lb. of milk contains ·65 ounce of flesh-formers and 1·51 ounce of heat-givers. Now the latter figure has been reached by adding together the fat and sugar of the milk without the previous conversion of the former into its starch-equivalent. It is needless after this to say how idle are all the subsequent comparisons of milk with other foods, vegetable and animal.

Marcus Ward's Arithmetic. J. W. Marshall, M.A., Assistant-Master at Charterhouse School. (London: Ward and Co., 1879. 232 pp.)

THIS is a neatly got up arithmetic; it contains a great number of exercises, covering the usual ground occupied by such treatises, has a modicum of explanatory matter, and calls for no further comment. There are no answers at the end, but they can be got in a separate form.

A Collection of Problems on Plane Geometrical Drawing, including Problems on a few of the Higher Plane Curves, &c. By E. F. Mondy, A.R.S.M. 2 vols. Text and Plates. (Tokei. 127 and ix. pp.)

A COLLECTION of problems arranged for the use of the students in the Imperial College of Engineering, by the First Whitworth Scholar (1871), and Professor of Drawing in the College. The author's aim has been to arrange the earlier problems so as to render it of service to students to work these while reading Wilson's Geometry, the text-book used in the Mathematical Class. The treatment is mainly founded upon the recognised English text-books, but a novel feature, perhaps, is the extent of space devoted to the conic sections and the higher plane curves, "especially as regards the use of equations to these curves and to the various geometrical elements connected with them."

Thus constructions are given for the tangents and radii of curvature, and problems in areas are worked out.

The book is, under the circumstances, very fairly got up as regards the printers' work, and the matter is deserving of commendation for its arrangement.

Our own experience of Japanese students is that they take very kindly to this branch of mathematical instruction, and the productions of some we could name rank among the neatest we have seen. The plates are in a separate work from the text, a convenience in some respects for the student.

Essai sur les Principes fondamentaux de la Géométrie et de la Mécanique. Par M. de Tilly. (Paris: 1878. 190 pp.)

THIS valuable treatise forms the first *cahier* of the third volume of the *Mémoires de la Société des Sciences physiques et naturelles de Bordeaux*, 2e série. The first chapter—General Geometry—discusses the elementary notions and axioms of the subject in a way that will satisfy an anti-Euclidian, but we fear the nerves of Euclidian adherents would suffer a shock at the bare-

faced manner in which triangles and figures are moved about and turned about and placed upon one another.

The second chapter treats of the subject as handled in the Elementary Treatises, taking chiefly for the basis of remarks the fourth edition of the Geometry, by Messrs. Rouché and De Comberousse.

Chapters III. and IV. are occupied with Trigonometry, and Chapter V., closing the work, treats of Mechanics. The volume is too technical to allow of an extended criticism here, but we can commend it to geometrical students. No statement is made as to how it comes to pass that such a volume was issued under the auspices of the Society named above.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

New Methods of Moving Ordnance

In anticipation of an interesting paper and discussion at the intended meeting of the British Association at Sheffield, a complete set of working models has been prepared at the Floating Dock, North Shields, to explain several new applications of a new method of moving ordnance with ease and rapidity of motion in small space, with economy of time and labour.

The most recent of these improvements is an adaptation of the principles of the tramway and tram car, in making use of the perfectly level surface, and the retaining groove, either on the ship's deck or on the platform of a battery. But instead of flanges on the wheels, that have a tendency to clog and compress dirt into the grooves, and "gag" on the edges, a hanging longitudinal guide-plate projects below the wheels on the inside of the rails; this allows greater freedom of action to the wheel and gives greater security, and in order to attain greater power of resistance to any shock or concussion, the guide plates are strengthened by a cross connecting the plate between them. The gun carriage slide has turn-table pivots on four wheels, that can be placed anywhere; as for the real or imaginary centres of motion at the ends, or centrally or to correspond with the present A B C D pivots of the Royal Artillery, which when in line or parallel or at any angle to each other act as stationary or moving pivots or fulcra for a lever movement of the slide, to turn or move in any direction on perfectly straight lines, as the shortest route between any two points, and also as best adapted for the application of a direct action of any of the usual mechanical motive powers.

North Shields, August 1 GEORGE FAWCUS

"Law of Frequency"

The term "law of frequency" seems to be used in two distinct senses by mathematical writers. In the ordinary theory the ambiguity leads to little confusion except to beginners; but this is owing to a fortunate, though altogether special, property of the hypothesis on which the theory is based. When we come to investigate other possible theories, it becomes highly important to keep the distinction in mind. Suppose, for clearness' sake, that we have before us a large number of measurements of a single unknown quantity. On examining them we find that a considerable number agree pretty closely with each other, several are more obviously discrepant, while one or two are widely so. Conversely we are led to think of the frequency with which a given measurement occurs as a function of the magnitude of the measurement itself. Denoting this magnitude by x, we may represent the relative frequency of its occurrence by $\phi(x)$. This function is called the "law of frequency of the measurement x," and it is in this sense that statisticians often use the phrase.

But if we consider all the possible measurements that may be made of the quantity, we see that their number is practically infinite. The relative frequency of any proposed measurement becomes therefore infinitesimal, and we must seek for some other expression. This we find by inverting our ideas, as it were, and asking, not "What is the frequency of a given measurement x?" but "What is the probability that a given measurement shall lie between the two very near values x and $x+\delta x$?" Suppose that our particular theory gives us this latter probability as $\psi(x)\,\delta x$. Then mathematicians generally are wont to call $\psi(x)$ "the law of frequency of the measurement x."

A little consideration will show that on one hypothesis only are $\phi(x)$ and $\psi(x)$ necessarily of the same form. This hypothesis is that the arithmetic mean of our fallible measurements is the best value of the quantity measured which we can obtain from them. From this the ordinary law, $\phi(x) \propto e^{-h^2x^2}$, easily follows.

But if the nature of our measurements (or other discrepant magnitudes) be such as to suggest that some other mean is likely to be nearer the truth than the arithmetic mean, we shall find that the forms of $\phi(x)$ and $\psi(x)$ are not the same. It seems, therefore, desirable that a real distinction in the things signified should be marked by a corresponding distinction in the terms applied to them. If it be not too bold a suggestion, might we not "desynonymise" the terms "law of frequency" and "law of facility," keeping the former for the function I have called $\phi(x)$, and the latter for the commoner function I have represented by $\psi(x)$? DONALD MCALISTER

St. John's College, Cambridge, July 28

Carica Papaya

Thanks to Mr. Whitmee for his timely correction of my perhaps too dogmatic assertion as to the seeds of the Papau being rejected by birds, at p. 241. Had I not written off-hand I should have qualified the sentence "the birds however will not touch them," *i.e.* the fruit, by adding "as far as I have observed."

We had flocks of small birds inhabiting the casuerinas and banyans which shaded our sea-side quarters at Rivière Noire, Mauritius; they were mostly small birds such as "bengalis," (*Estrelda amandava*), "senegalis," (*Estrelda astrilda*), "calfats," (*Munia oryzivora*) "tuit-tuits," (*Oxynotus ferrugineus*), cardinals, crithagras, serins, &c., as numerous as finches and sparrows in our English gardens: but never did I see any of these birds, which were as bold and tame as possible, peck at the papaus either on the plants or on the ground; had they been in the habit of doing so I must have observed them. The "martins" or minas of the interior did not trouble us with their visits and noisy chatterings, so I cannot say whether they affect the papau seeds much. It is possible that the "pigeons marrons" and various "tourterelles" may have fed on the papau fruit but I never found any of the seeds in their crops.

The flying foxes, "collets rouges," (*Pteropus Edwarsii*), used to come down in numbers to eat the mangoes of our neighbour, Mons. Genéve; when we used to shoot them on moonlight nights and find them remarkably good eating, but I never knew or heard of their eating the papau, which perhaps they do. The conditions of the Mascarene and Navigator's islands are probably different, as the *Carica* certainly does not spring up as a weed wherever forests are cleared in Mauritius, or Bourbon. The *Carica papaya* figures as a *cultivated* and not an *intrusive* plant in Dr. Charles Pickering's table of observed localities of plants introduced throughout Polynesia; distinguishing for each plant, whether it appears to be native, or spontaneously disseminated, and whether when introduced apparently by the hand of man it has become naturalised or *intrusive*. Certainly Dr. Pickering's work is out of date (1848), and I have not yet seen his new work *Chronological History of Plants* (Trübner, 1879).

Whilst on this subject I may subjoin a paragraph I came across in a number of the *Gardener's Chronicle* about the papau, with which I conclude.

"*Utilisation of the Papaw.*—The peculiar properties of the Papaw (*Carica papaya*) in causing the separation of animal tissues, and thus rendering newly-killed meat tender, is a fact that has been frequently written about and commented upon by travellers. Our contemporary, *The Chemist and Druggist*, suggests, as a 'possible specialty,' the production of some convenient preparation from the tree which should contain the same properties as the leaves, or whether the leaves themselves might be dried and still retain their activity. 'There is no doubt,' they say, 'that a preparation which really embodied